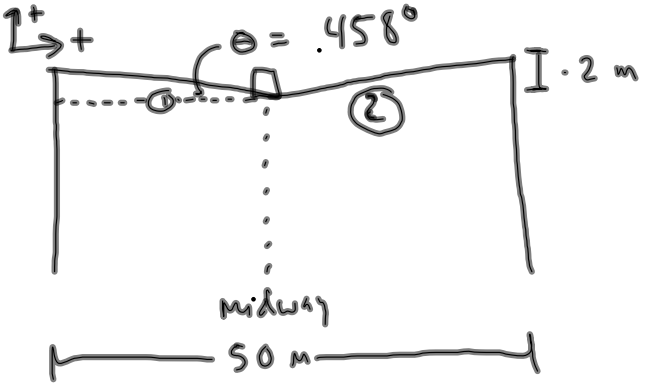
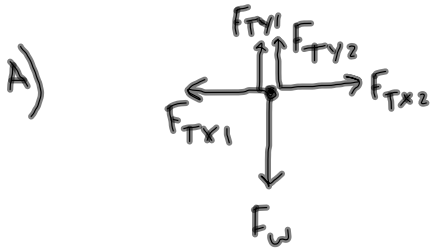
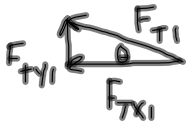
Friction Notes and Practice Problems 9.12.11

The distance between two telephone poles is 50.0 m. When a 1.00 kg bird lands on the telephone wire midway between the poles, the wire sags 0.200 m. Draw a free-body diagram of the bird. How much tension does the bird produce in the wire? Ignore the weight of the wire.



A)





B) $\sum F_x = 0$ $\quad\quad$ $\sum F_y = 0$

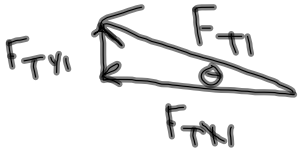
$-F_{TX1} + F_{TX2} = 0$ $\quad\quad$ $F_{TY1} + F_{TY2} - F_W = 0$

$F_{TX1} = F_{TX2}$ $\quad\quad$ $F_{TY1} + F_{TY2} = F_W$

$= 9.8\ N$

from symmetry in problem: $F_{TY1} = 4.9\ N$

$F_{TY2} = 4.9\ N$



$\theta = .458°$

$\sin\theta = \frac{F_{TY1}}{F_{T1}}$

$F_{T1} = \frac{F_{TY1}}{\sin\theta}$

$= \frac{4.9\ N}{\sin(.458°)}$

$= 613\ N$

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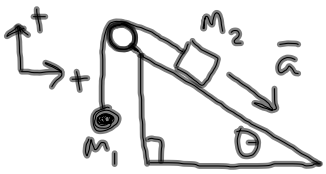
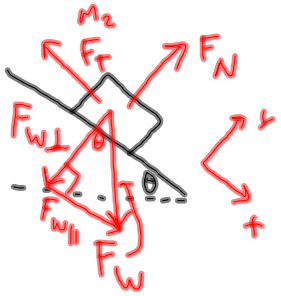
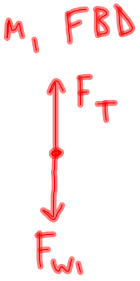
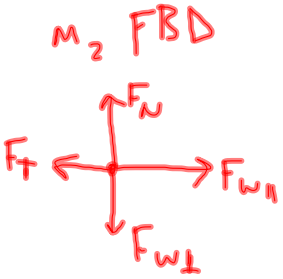
A ball of mass m_1 and a block of mass m_2 are attached by a lightweight cord that passes over a frictionless pulley of negligible mass. The block lies on a frictionless incline of angle theta. Find the magnitude of the acceleration of the two objects and the tension in the cord.









m_1

$\sum F_x = 0$

$\sum F_y = m_1 a$

$F_T - F_{W_1} = m_1 a$ ①

$F_T = m_1 a_g + m_1 a$

$= m_1(a_g + a)$

m_2

$\sum F_\perp = 0$

$F_N - F_{W2\perp} = 0$

$F_N = F_{W2\perp}$

$\sum F_{11} = m_2 a$

$-F_T + F_{W2\,11} = m_2 a$

$-F_T + m_2 a_g \sin\theta = m_2 a$

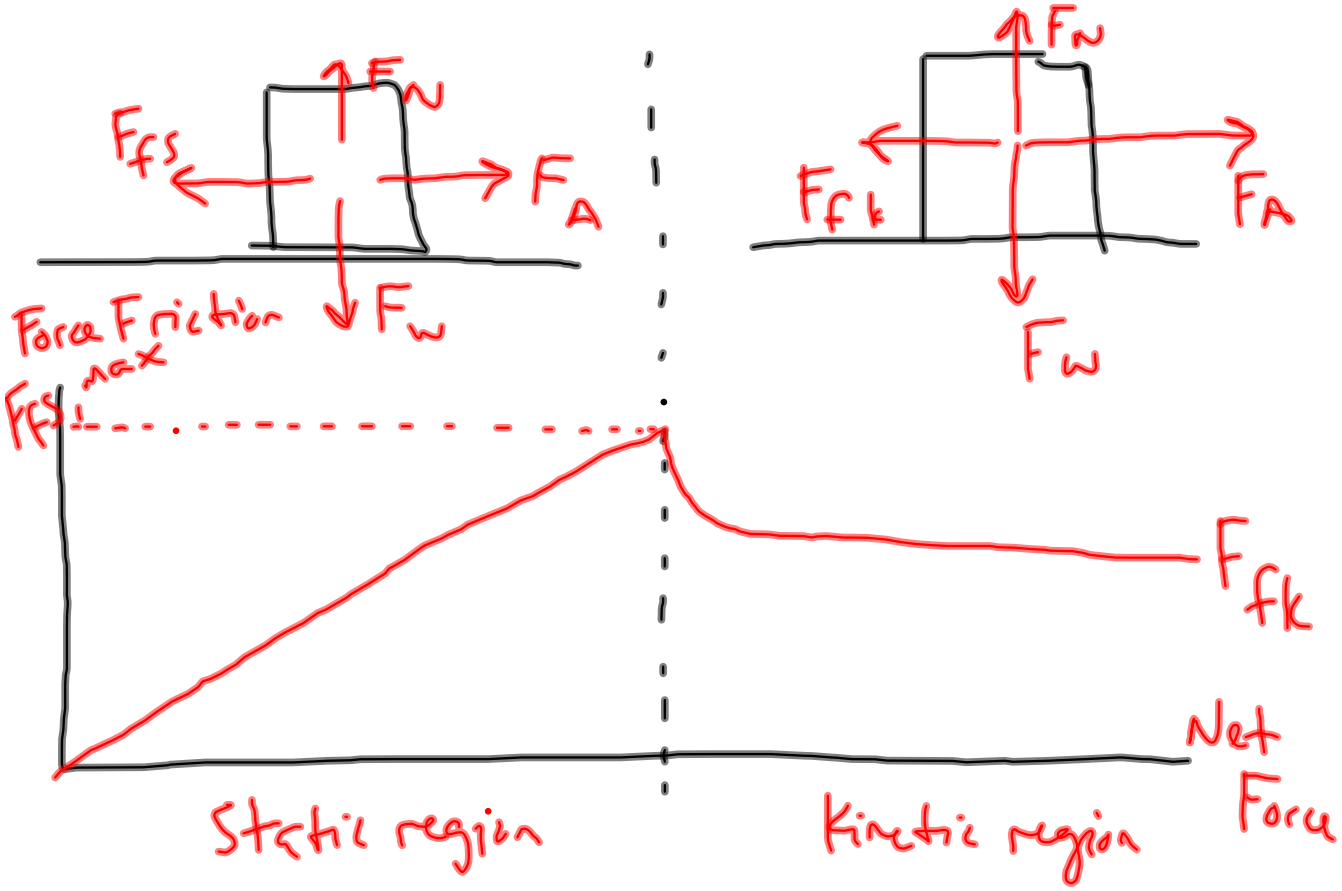
$-m_1 a_g - m_1 a + m_2 a_g \sin\theta = m_2 a$

$m_1 a + m_2 a = m_2 a_g \sin\theta - m_1 a_g$

$$a = \frac{m_2 a_g \sin\theta - m_1 a_g}{m_1 + m_2}$$

$F_T = m_1(a_g + a)$

$$= \frac{m_1 m_2 a_g (\sin\theta + 1)}{m_1 + m_2}$$



$$F_{fs} = \mu_s F_N$$

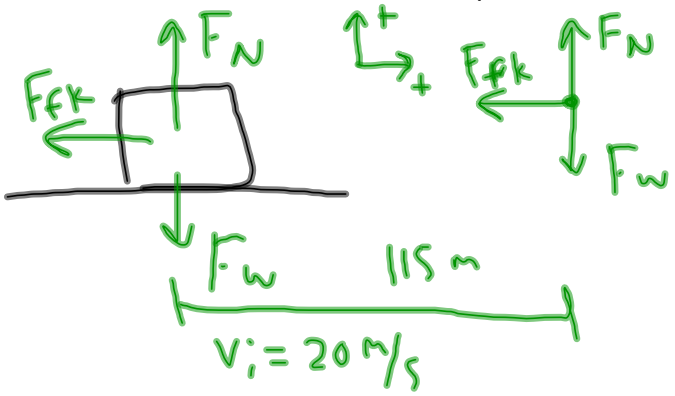
$$F_{fk} = \mu_k F_N$$

μ = coefficient of friction

unitless quantity

Friction Notes and Practice Problems 9.12.11

A hockey puck on a frozen pond is given an initial speed of 20.0 m/s. If the puck always remains on the ice and slides 115 m before coming to rest, determine the coefficient of kinetic friction between the puck and ice.



$$\Sigma F_y = 0 \qquad \Sigma F_x = ma$$

$$F_N - F_w = 0 \qquad -F_{fk} = ma$$

$$F_N = F_w = mg \qquad -\mu_k F_N = ma$$

$$-\mu_k mg = ma$$

$$\mu_k = \frac{-a}{g}$$

$$v_f^2 = v_i^2 + 2a\Delta x \quad (v_f = 0)$$

$$a = \frac{-v_i^2}{2\Delta x}$$

$$\mu_k = \frac{-\left(\frac{-v_i^2}{2\Delta x}\right)}{g}$$

$$= \frac{v_i^2}{2g\Delta x}$$

$$= .177$$

HW: p.130 : 23, 27, 29

p.131 : 35, 37

Due 9/14, Wednesday